

129437 FAA-01-8994-1

OCT 28 1994

Mr. James E. Dougherty
GAMA
1400 K Street NW, Suite 801
Washington, DC 20005-2485

Dear Mr. Dougherty:

Thank you for your October 14 letter forwarding the Aviation Rulemaking Advisory Committee (ARAC) recommendations regarding type certification procedures for changed products and advisory material for establishing the certification basis of changed aeronautical products.

The recommendations were submitted in a format suitable for processing, and therefore will be presented to the Federal Aviation Administration (FAA) management as quickly as possible. If management agrees with the recommendations, the one regarding procedures will be published in the Federal Register as a notice of proposed rulemaking and a notice of availability will be published for the advisory material.

I would like to thank the aviation community for its commitment to ARAC and its expenditure of resources to develop the recommendations. We in the FAA pledge to process them expeditiously as high-priority actions.

Again, let me thank the ARAC and in particular the International Certification Procedures Working Group for its prompt action on the task that the FAA imposed.

Sincerely,

Original Signed By:
Anthony J. Broderick

Anthony J. Broderick
Associate Administrator for
Regulation and Certification



ARM Act
10/28

**General Aviation
Manufacturers Association**

1400 K Street NW, Suite 801
Washington, DC 20005-2485
(202) 393-1500 • Fax (202) 842-4063

October 14, 1994

Mr. Anthony J. Broderick
Associate Administrator for
Regulations and Certification (AVR-1)
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Mr. Broderick

On behalf of the Aviation Rulemaking Advisory Committee, I am pleased to submit the enclosed recommendations for FAA publication. They are identified as:

1. Draft NPRM, August 29, 1994, "Type Certification Procedures for Changed Product."
2. Draft AC 20-ICPTF, August 24, 1994, "Advisory Material for Establishing the Certificatio Basis of Changed Aeronautical Products."

It was developed by the ICPTF Working Group chaired by Webb Heath. The membership of the Group is a good balance of interested parties in the U.S., Europe, and Transport Canada. The Group can be made available if needed for docket review.

The JAA advised Mr. Heath in a telephone conversation on October 13, 1994, that a minor difference exists in the Draft AC, but that its nature is such that it will be handled internally by them. Therefore, the package is acceptable to the JAA and should be moved favored.

The members of the ARAC 21 Issues Group discussed and fully endorsed the package at its scheduled meeting October 13, 1994, and asked the FAA be advised to proceed with the issuance process as a non-significant change.

Very truly yours,


James E. Dougherty

Assistant Chairman, Certification
and Procedures Issues Group (ARAC 21)

copy Webb Heath



DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

[14 CFR Parts 11, 21, and 25]

[DOCKET No. xxxxx; Notice No. xx-xxx]

RIN: 2120-AE93

Type Certification Procedures for Changed Products

AGENCY: Federal Aviation Administration, DOT

ACTION: Notice of Proposed Rulemaking (NPRM)

SUMMARY: This notice proposes to amend the procedural regulations for the certification of changes to type certificated products. The amendments are needed to accommodate the trend toward fewer products that are of completely new design and more products with repeated changes of previously approved designs. Safety would be enhanced by applying the latest airworthiness standards, to the greatest extent practical, for the certification of certain design changes of aircraft, aircraft engines, and propellers.

DATES: Comments must be received on or before [Insert __ days after publication in the Federal Register.]

ADDRESSES: Comments on this proposal must be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket

No. , 800 Independence Avenue SW, Washington, DC 20591, or delivered in person to room 915G at the same address. Comments may be inspected in room 915G weekdays, except Federal holidays, between 8:30 am and 5:00 pm.

FOR FURTHER INFORMATION CONTACT: Lyle C. Davis, Policy and Procedures Branch (AIR-110), Aircraft Certification Service, Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, telephone (202) 267-9588.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the proposed rulemaking by submitting such written data, views, or arguments as they may desire. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket at the address specified above. All comments will be considered by the Administrator before action on the proposed rulemaking is taken. The proposals contained in this notice may be changed in light of the comments received. All comments will be available in the Rules Docket, both before and after the closing date for comments, for examination by interested persons. A report summarizing each substantive public contact with Federal Aviation Administration (FAA) personnel concerning this rulemaking will be filed with the docket. Commenters wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped

postcard on which the following statement is made:

"Comments to Docket No. . " The postcard will be dated and time stamped and returned to the commenter.

Availability of NPRM

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Information Center, APA-430, 800 Independence Avenue SW, Washington, DC 20591; or calling (202) 267-3484. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future NPRMs should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application process.

Background

Statement of the Problem

Under the regulations in effect prior to the early 1940's, an applicant for a changed product, such as an alternate engine installation, was required to apply for a new type certificate and comply with the standards current at the time of application. This did not present an unreasonable burden on the applicant then because the airworthiness standards did not change appreciably over a period of time. That is, the standards current at the time

of an application were essentially the same as those with which the original product had to comply. Since the early 1940's, however, rapid changes in technology have resulted in significant changes in the airworthiness standards over relatively short periods of time. Therefore, an applicant for an extensive change to a type certificated product, which required a new type certificate, could be faced with complying with safety standards that varied considerably from the standards for the original product. To relieve this situation, the FAA's predecessor agency required an application for a new type certificate only if the change was quite extensive.

In recent years, a trend has developed towards fewer products that are of such significantly new design that a new type certificate is required. In many cases, over a period of time, a series of changes could permissively be made to a product by amending its original type certificate such that the resultant model is substantially different from the original model. Although each changed product in such a series of changes may differ little from its immediate predecessor, the changes could collectively result in a product with substantial differences from the original product. As a result, many newly manufactured aeronautical products are not being required to show compliance with the more recent airworthiness standards. The procedural regulations need to be changed to correspond with this trend

toward fewer new type certificates.

History of Type Certification

The Federal Aviation Act of 1958 (the Act) authorizes the FAA Administrator to promote safety of flight of civil aircraft in air commerce by prescribing and revising minimum standards governing the design and construction of aircraft, aircraft engines, and propellers as may be required in the interest of safety and such minimum standards governing appliances as may be required in the interest of safety. (49 U.S.C. 1421)

Under section 603 of the Act, the FAA may issue type certificates for aircraft, aircraft engines, and propellers. The FAA may prescribe in any such certificates the duration of the certificate, and the terms, conditions, and limitations as required in the interest of safety. (49 U.S.C. 1423)

The general certification procedures for products and parts (aircraft, aircraft engines, and propellers) are set forth in 14 CFR part 21 (part 21). As described in §§ 21.13 and 21.15, any interested person may apply for a type certificate by submitting an application accompanied by the required documentation to the FAA. Sections 21.16 through 21.21, 21.101, and 21.115 specify certain regulations and designate the applicable airworthiness standards for type certification of both new and changed products.

Section 21.17 designates the applicable regulations for the issuance of type certificates. In order to be issued a type certificate, the applicant must show that the product complies with the airworthiness standards contained in one of the following 14 CFR parts as applicable: part 23 for normal, utility, acrobatic, and commuter category airplanes; part 25 for transport category airplanes; part 27 for normal category rotorcraft; part 29 for transport category rotorcraft; part 31 for manned free balloons; part 33 for aircraft engines; part 35 for propellers; and part 21 (§ 21.17(b) and (f)) for special classes of aircraft and primary category aircraft respectively.

The airworthiness standards in these parts of the Federal Aviation Regulations may be amended as needed to reflect continually changing technology, correct design deficiencies, and provide for safety enhancements. An applicant for a type certificate is required under current § 21.17, with certain exceptions, to show that the product meets the applicable airworthiness standards that are in effect on the date of the application. The exceptions include instances in which the Administrator specifies otherwise or in which the applicant either elects or is required under specific circumstances to comply with later effective amendments. In addition, the Administrator may prescribe special conditions.

Under § 21.16, special conditions may be prescribed if

the Administrator finds that the existing airworthiness standards do not contain adequate or appropriate safety standards because of novel or unusual design features of the product to be type certificated. Also, under § 21.21(b)(1), if any applicable airworthiness standards are not complied with, an applicant may nevertheless be entitled to a type certificate if the Administrator finds that those standards not complied with are compensated for by factors that provide an equivalent level of safety. Such determinations are commonly referred to as "equivalent safety findings." In addition, under § 21.21(b)(2), an applicant may be denied a type certificate if the Administrator finds an unsafe feature or characteristic of the aircraft for the category in which type certification is requested, even though the aircraft may comply fully with the applicable airworthiness standards.

Taken together §§ 21.16, 21.17, and 21.21 designate the applicable regulations for type certification and accommodate those circumstances when the airworthiness standards do not adequately cover the design features of a product. These sections recognize and balance the following four important considerations:

(1) The obligation of the FAA, under Section 601 of the Act, to keep the minimum airworthiness standards required in the interest of safety, (i.e., parts 23, 25, 27, 29, 31, 33 and 35) as current as practical;

(2) The type certificate applicant's need to know what the applicable airworthiness standards will be in order to finalize the detailed design of its product and to enable the applicant to make reasonable performance guarantees to its potential customers;

(3) The need for the FAA to issue special conditions to address truly novel or unusual design features that it has, as yet, not had an adequate opportunity to address in the airworthiness standards through the general rulemaking process; and

(4) To allow flexibility in design. The airworthiness standards of 14 CFR Chapter 1, subchapter C, are intentionally objective in nature, and the procedural regulations permit design changes.

Originally, the FAA would issue special conditions informally as an interpretation of the "no unsafe feature or characteristic" regulations; however, in 1967, the FAA formalized the process with the adoption of § 21.16. As provided in that section, special conditions are issued as regulations in accordance with public comment provisions of 14 CFR part 11 (part 11). The adoption of § 21.16 extended the special condition process to include aircraft engines and propellers. The provision in § 21.21(b)(2), that a type certificate would be issued for an aircraft only if no unsafe feature or characteristic existed, remained unchanged.

The phrase "novel or unusual" is used in describing design features for the issuance of special conditions under the provisions of § 21.16. These design features involve a state of technology not envisaged by the applicable airworthiness standards at the time they were written; in some areas, the state of the regulations may lag the state of the art of new designs. This disparity is due both to the rapidity in which the state of the art is advancing in civil aeronautical design and the need to develop a sufficient experience base before proceeding with general rulemaking. Therefore, there may be instances in which special conditions are required for design features considered "state of the art" in the aircraft industry. Conversely, many new design features that might be thought of as "novel or unusual" in the context of the product's original certification basis may already be covered by existing regulations, thereby obviating the need to issue special conditions.

For example, in 1980, the holder of a small airplane type certificate who installed turboprop engines in place of reciprocating engines did so by complying with appropriate later regulations. Because appropriate regulations were available for the installation of turboprop engines, special conditions were not issued for installation of the engines. These changes were made through the FAA issuing an amendment to the type certificate originally issued in 1964. The

regulations were changed to accommodate turboprop engines in 1969.

Special conditions are not issued for general upgrading of the applicable airworthiness standards to achieve a higher level of safety. Whenever the FAA concludes that a compelling need exists for a higher level of safety in designs already type certificated or designs for which a type certificate application is in progress, rulemaking is proposed in accordance with the general rulemaking procedures of part 11, the Administrative Procedure Act, and Executive Order 12866.

Sometimes new airworthiness standards contain provisions that, in the interest of safety in air transportation, should be applied retroactively to aircraft used in air carrier service. Typically this is accomplished by proposing changes to 14 CFR parts 121 and 135 through rulemaking procedures. In addition, 14 CFR part 91 is sometimes used as the vehicle for retroactive regulations for general aviation aircraft. Finally, §§ 23.2, 25.2, 27.2, and 29.2 provide retroactive regulations in the airworthiness standards. Any proposed retroactive action is supported by a regulatory analysis completed in accordance with Executive Order 12866. Public comments are then considered in determining the applicability of the final regulation.

History of Type Certification of Changes

Part 21 designates the applicable airworthiness standards for changed products. Section 21.19 describes the circumstances in which an applicant for type certification of a changed product must apply for a new type certificate. Prior to the early 1940's, an applicant for a changed product, such as an airplane with an alternate engine installation, was required to apply for a new type certificate. The regulations in effect prior to the early 1940's required an applicant for a changed product to apply for a new type certificate for a change such as an alternate engine installation. When a new type certificate was required, the applicant had to comply with the standards current at the time of application. This did not present an unreasonable burden on the applicant then because the airworthiness standards did not change appreciably over a period of time. The current standards were, therefore, essentially the same as those with which the original product had to comply. Later, more rapid changes in technology resulted in significant changes in the airworthiness standards over relatively short periods of time. An applicant for a type certificate for a changed product could thus be faced with complying with airworthiness standards that varied considerably from those with which the original product complied. In some instances, the differences in standards could be so great

that an applicant would be discouraged from making any changes, including changes that would, in themselves, contribute to the safety of the product. To relieve this situation, by the early 1940's, an application for a new type certificate was required only if the change was quite extensive.

Section 21.19(a) requires a new type certificate when a change is considered so extensive that a substantially complete investigation of compliance with the regulations is required. In addition, §§ 21.19(b), (c), and (d) provide specific types of changes that require an application for a new type certificate. For a normal, utility, acrobatic, commuter, or transport category aircraft, paragraph (b) requires a new aircraft type certificate if the proposed change is (1) in the number of engines or rotors, or (2) to engines or rotors using different principles of propulsion or to rotors using different principles of operation. Similarly, paragraph (c) requires a new engine type certificate if the proposed change is in the engine's principle of operation, and paragraph (d) requires a new propeller type certificate if the proposed change is in the number of blades or in the principle of pitch change operation.

The basis for § 21.19(b)(1) originated in the early 1950's following the issuance of an amended type certificate to an applicant who altered a popular single-engine, four-

passenger, light airplane into a twin-engine model. Although that conversion was approved by an amendment to the original type certificate, the agency recognized that the conversion from one to two engines added considerable complexity to the airplane and greatly affected its handling characteristics. Therefore, the predecessor of § 21.19(b)(1) was adopted requiring a new type certificate for a change in the number of engines or rotors. The regulatory language was broad enough in scope to include any change in the number of engines or rotors whether such changes would simplify or add complexity to the type design. Section 21.19(b)(1) also requires a new application for rotorcraft if the number of rotors is changed.

The FAA does not require an applicant to apply for a new type certificate to add small standby or auxiliary engines to an aircraft. In the 1960's, with the development of small turbojet engines to be used as auxiliary engines, the FAA defined a jet engine that develops less than 50 percent of the static thrust developed by one of the primary propulsion engines as an auxiliary engine. The FAA considers the "number of engines" as used in § 21.19(b)(1) to refer to the number of primary propulsion engines and not to any standby or auxiliary engines to be installed. The regulation concerning a change in the number of engines has been the basis for a large number of exemptions issued to applicants wishing to change the number of engines on type

certificated aircraft.

Prior to 1957, predecessors of current § 21.19(b)(2) stated that an applicant must make a new application for type certificate if the proposed change was to engines employing different principles of operation or propulsion. This meant that an applicant desiring to replace reciprocating engines with the same number of turbopropeller engines would have to apply for a new type certificate. During that period, it was recognized that considerable advances in safety, reliability, and passenger comfort could be realized by replacing reciprocating engines in certain transport category airplanes with turbopropeller engines. In order to encourage such beneficial changes, the reference to different principles of operation was deleted in 1957 for transport category airplanes. As a result, an applicant may be granted approval for a conversion of this nature without applying for a new type certificate providing the applicant complies with certain later standards applicable to turbine-powered airplanes. In the broadest sense, all powered airplanes achieve propulsion by accelerating a mass of air and/or exhaust gases. In the narrower context of § 21.19(b)(2), however, "principles of propulsion" means propeller-driven versus turbojet.

Section 21.19(b)(2) also states that an applicant must make a new application for a type certificate if the proposed change is to rotors employing different principles

of operation or propulsion. The FAA is not aware of any instance in which this specific section was the basis for requiring an application for a new type certificate. This is probably due to the fact that any change of this nature, together with all related changes, would have been so extensive that a new type certificate would have been required under the provisions of § 21.19(a)..

The FAA has never granted any exemptions from the regulation for a new aircraft type certificate for a change to engines or rotors using different principles of propulsion. Similarly, no exemptions have been granted from the engine or propeller type certificate regulations for changes involving the principle of engine operation, for changes in the number of propeller blades, or in the principle of pitch change operation.

Under § 21.101, the original type certificate may be amended to include changes to the product when the applicant demonstrates that it complies with the same airworthiness standards as the original product, and the change does not warrant making a new application for a type certificate under § 21.19. Because § 21.101 is incorporated by reference in § 21.115, these procedures are equally applicable to persons applying for supplemental type certificates.

Section 21.101(a) requires that an applicant for a change to a type certificate must comply with either the

regulations incorporated by reference in the type certificate or the applicable regulations in effect on the date of application, plus any other amendments the Administrator finds to be directly related. The "regulations incorporated by reference" are the regulations that were the certification basis for the original issuance of the type certificate. They are frequently referred to as the "original certification basis."

If an applicant chooses to show compliance with the regulations in effect on the date of the application, the applicant must also comply with any other amendments that are directly related. In some instances, a regulation may be amended to become less stringent, but a related regulation may become more stringent. In a situation of this nature, the applicant must also comply with the related compensating regulation as well.

An applicant for a change to a type certificated product is responsible for showing that the entire product, as altered, not just that the change itself, complies with the certification basis, because areas that have not been changed may be affected by the change. However, the applicant need not resubstantiate those areas of the product where the original substantiation has not been invalidated by the change.

Section 21.101(b) pertains to changes for which the regulations incorporated by reference do not provide

adequate standards. Such changes generally involve features that were not envisaged at the time the regulations incorporated by reference were adopted and are, therefore, novel or unusual with respect to those regulations. For these changes, the applicant must comply with regulations in effect on the date of application for the change as found necessary to provide a level of safety equal to that established by the regulations incorporated by reference. When regulations in effect on the date of application for the change fail to provide adequate standards, the applicant must comply with special conditions to provide a level of safety equal to that established by the regulations incorporated by reference.

Trends in Type Certification of Changes

In recent years, a trend has developed towards fewer products that are of completely new design requiring a new type certificate. Over a period of time, a series of changes to an original product may have been made so that the current model is substantially different from the original model. Although each changed product in such a series of changes may differ little from its immediate predecessor, the changes could result collectively in a product with substantial differences from the original product. For example, one model originally manufactured as a normal category airplane with two reciprocating engines

has been changed through a series of alterations to incorporate turbopropeller engines, a stretched and heightened fuselage, a tricycle landing gear, a modified wing planform and a 42 percent increase in maximum takeoff weight. In this particular case, the majority of changes were made through the FAA's issuing supplemental type certificates to modifiers other than the type certificate holder. However, the type certificate holder could have made the same incremental changes without applying for a new type certificate each time. For example, in another instance, a type certificate holder effected significant changes in the design of a turbojet transport category airplane without obtaining a new type certificate by making a series of changes to its existing type certificate. Each incremental change, by itself, was determined not to be so extensive as to require a new type certificate under § 21.19(a). This airplane evolved into a configuration approximately 40 percent greater in fuselage length and with a 92 percent greater maximum takeoff weight than the original model. These changes, which have been incorporated into newly manufactured airplanes, were made through the FAA issuing amendments to the type certificate.

Another trend in manufacturing is to keep products in production over several decades. Some currently manufactured transport category airplanes have, for example, evolved from airplane models originally type-certificated 25

years ago. This does not imply that those airplanes are "unsafe," because they do, in practice, have features that address the intent of most of the current standards. However, current procedural regulations (part 21) do not require that changed products comply with the current standards.

It would seem, for consistency, that new airworthiness standards should apply across the board to the entire aircraft fleet; however, application of new standards would not be feasible in every case. Although newly designed aircraft are required to meet all applicable current airworthiness standards, in many cases products being changed, for which only an amended type certificate is needed, are required to meet only the standards referenced in the original type certificate. Thus, there may be a considerable difference between the standards required for a new product and for a product undergoing change. A product undergoing change that met the applicable standards at the time of original type certification need not meet more current airworthiness standards except in those instances where retroactive regulations have been issued or the applicant elects to comply with later amendments.

In recent rulemaking, the FAA has carefully considered whether corresponding retroactive action is warranted whenever a change to the airworthiness standards for type certification is proposed. In those cases where it has been

deemed that a safety benefit commensurate with the cost could be achieved, the rulemaking has also included a proposal to change the relevant operating regulations to require newly manufactured airplanes and airplanes in service to comply retroactively with the new standards, regardless of whether such compliance would be required as a condition of type certification. In some instances, the action proposed for newly manufactured products differed from that proposed for products already in service. For example, some of the regulations implemented in recent revisions to part 25 were not required for the existing fleet and were not implemented in the operating regulations, such as part 121.

In 1965, the FAA granted an exemption from the provisions of § 21.19(b)(1) to permit conversion of a four-engine amphibian to a twin-engine configuration without the applicant applying for a new type certificate. During the 1980's, three applicants petitioned for exemptions from the above regulations so they could convert Boeing 727 airplanes from the original three-engine configuration to one with two engines without having to apply for a new type certificate. Another applicant petitioned for a similar exemption to replace the four engines of a Lockheed 1329 Jetstar aircraft with two engines of more recent vintage. The FAA granted each exemption with the condition that the petitioner comply with the provisions of then current part 25 in all areas,

systems, components, equipment, or appliances affected by the conversion. The appropriateness of the regulation being applied to a design change involving a reduction in the number of engines may be questioned because of the simplification involved; nevertheless, rulemaking to change this regulation has not been undertaken.

The FAA also granted a number of exemptions that permitted increasing the number of engines without the need for the applicants to obtain new type certificates. In 1985, an applicant received an exemption to replace two reciprocating engines in Grumman Albatross amphibians with four turbopropeller engines without having to obtain a new type certificate. In granting the exemption, the FAA concurred that the alteration should improve the Albatross by increasing safety, increasing powerplant reliability, and improving overall aircraft efficiency. The exemption noted that strict compliance with § 21.19(b)(1) would have required changes to some basic systems that had provided satisfactory performance for many years and had contributed to the safety record of those airplanes. Applying then-current regulations to components and systems not affected by the installation of the four engines would have been time-consuming and costly, and would not necessarily have led to a higher level of safety. As with the exemptions to reduce the number of engines, this exemption was granted with the condition that the petitioner comply with the

provisions of then current part 25 in all areas, systems, components, equipment, or appliances affected by the conversion.

A similar exemption was also granted in 1989 to enable an applicant to increase the number of engines from one to two in certain Bell 206 series rotorcraft. The petitioner cited the increased safety afforded by a twin-engine configuration in the event a failure occurred during hover, and also the enhanced altitude performance. As a condition of the grant of exemption, the applicant was required to show that the altered rotorcraft complied with the standards of part 27 in effect on the date of application for the change for all areas, systems, equipment, or appliances that were changed or significantly affected by the change.

These exemptions point out two important features that have been included in this proposed rulemaking. One is that the number of engines is not, in itself, an appropriate criterion for requiring an application for a new type certificate. Second, the concerns that originally prompted this regulation are satisfied by the condition of the exemptions that the applicants for the change in type design comply with the regulations effective on the date of the application for the change in those areas affected by the change.

Recent FAA Actions

Apart from safety considerations, there has also been a growing international concern that some changed products are given an unfair competitive advantage over those that are of new design, which must comply with later standards.

Because of these concerns, the FAA has participated in the activities of an ad hoc committee sponsored by the Aerospace Industries Association of America, known as the International Certification Procedures Task Force (ICPTF). In addition to the FAA, this task force includes representatives of the European Joint Aviation Authorities, Transport Canada, Aerospace Industries Association of America, Air Transport Association of America, General Aviation Manufacturers Association, International Air Transport Association, Association Europeenne des Constructeurs de Materiel Aerospatial, Aerospace Industries Association of Canada, Air Line Pilots Association, and Association of European Airlines.

The ICPTF was organized to develop the philosophy and the necessary regulatory text and advisory material that provides for the implementation of later regulatory amendments applicable to aeronautical products undergoing change, products in production, and products in service. The specific tasks of the ICPTF were: (1) Develop the type certification philosophy for changes to aeronautical products, including revisions to the regulations and associated advisory material; (2) Develop the necessary

guidance information on the use of "service experience" in the type certification process; and (3) Develop a method to evaluate the safety impact and cost effectiveness of revisions to the airworthiness standards.

In order to develop future proposed safety standards by using a system-type analysis, the FAA chartered a committee of safety experts, known as the Aviation Rulemaking Advisory Committee (ARAC), on February 5, 1991. This committee established the International Certification Procedures Harmonization Working Group, which consists of the original ad hoc committee formerly known as the ICPTF. The purpose of this working group is to recommend to ARAC various rulemaking proposals pursuant to its area of expertise. ARAC can then make recommendations to the FAA, and the FAA decides whether or not to issue a proposal based on the ARAC recommendation.

The Working Group has made recommendations to ARAC concerning the type certification procedures for changes to aeronautical products, newly manufactured products, and products already in service. The rulemaking proposed by the FAA in this notice reflects the task force and ARAC recommendations in the type certification procedures for changed products. Similar corresponding changes are also being proposed by Transport Canada, and the Joint Aviation Authorities.

FAA Policy on Changed Products

The FAA intends to require that applicants for changes to type certificated products show compliance with the latest amendments to the airworthiness standards that are applicable to the product being changed. Exceptions to requiring a showing of compliance with the latest amendments would be provided to accommodate variations in the kinds of type certificated products, of changes to these type certificated products, and revisions of the airworthiness standards. These exceptions would permit compliance with regulations issued prior to the regulations in effect on the date of application for the change. The exceptions would include products that have not undergone a significant change, and those portions of the product, undergoing a significant change, that are not related to the change. In addition, the exceptions would include those later amendments that would not materially increase the level of safety of the product to be changed, or those that compliance with which would be impractical.

This proposed rulemaking would amend the type certification procedures for changes to type certificated products to bring the certification basis for changed products and for newly type certificated products closer together. The intent is to ensure that when an essentially new product is developed through a series of changes, regardless of the extent of each change, the final product

achieves a level of safety similar to that of a comparable new product. However, this concept will be tempered with the knowledge that a good design does not become unsafe as soon as a new regulation has been published.

The FAA is already requiring certain type certificated products that undergo alteration to comply with later amendments of the airworthiness standards. By this rulemaking, the FAA intends to broaden the scope of this policy to include changes being proposed for all type certificated products.

Some differences may be acceptable between the certification basis for a product undergoing a change and the current regulations that would be used if a new product was being type certificated. This acceptance would be based on there not being a defined safety issue involved in the specific product. The FAA has determined that the long term result of this approach will be that an amended type certificate will have a certification basis that provides a comparable level of safety to that of a new type certificate for the same product.

The FAA will issue an advisory circular based on recommendations of the ARAC. This advisory circular will provide guidance on determining the certification basis for changed aeronautical products, including identifying the conditions under which it will be necessary to apply for a new type certificate. By separate notice (

), the FAA is also inviting interested persons to comment on the proposed advisory circular.

Discussion of the Proposed Rulemaking

Sections 11.11, 21.19, 21.101, 21.115, and 25.2 would be amended as follows to implement the policy discussed above in relation to changes to products:

Section 11.11

Current § 11.11 lists special conditions required as prescribed under § 21.101(b)(2) as an FAA record that is maintained in current docket form in the Office of the Chief Counsel. To remain consistent with the proposed changes to § 21.101, it is necessary to amend § 11.11 to refer to § 21.101(c) instead of § 21.101(b)(2). This is not a substantive change.

Section 21.19

Current § 21.19(a) states that any person who proposes to change a product must make a new application for a type certificate if the Administrator finds that the proposed change in design, configuration, power, power limitations (engines), speed limitations (engines), or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required. This sentence has caused confusion because it covers several

types of changes for all products -- airplanes, rotorcraft, aircraft engines, and propellers. In addition, current paragraphs (b), (c), and (d) list other specific types of changes that mandate a new application for a type certificate. Only the general language of current paragraph (a) would be incorporated into the new § 21.19, while the previously listed specific changes would be subject to case-specific evaluations to determine whether they are substantial. Application of § 21.19 would depend upon an evaluation of whether the proposed change in "design, power, thrust, or weight" would necessitate a substantially complete investigation of the compliance of the changed product. Any of the following airplane design changes, considered alone, could typically be regarded as a substantial design change:

- (1) Change from high wing to low wing, or vice versa;
- (2) Change of empennage configuration for larger airplanes (cruciform vs 'T' or 'V' tail);
- (3) Complete repositioning of engines (tail to wing, etc.); and
- (4) An increase in airplane complexity resulting from an increase in the number of engines.

Current § 21.19(b) describes specific changes for which the applicant must apply for a new aircraft type certificate. These include (1) changes in the number of engines or rotors; and (2) changes to engines or rotors

using different principles of propulsion or to rotors using different principles of operation. Invariably, these types of changes fall into one of two categories -- those that are not substantial enough to require a new application for a type certificate, as evidenced by the large number of exemptions that have been granted over the past quarter century, or those that are so extensive that a new application would be required in any event because a complete investigation of compliance is required.

Accordingly, the provisions of current § 21.19(b) are not needed and would be deleted altogether. The exemptions that have been granted from current § 21.19(b) have typically required that those areas, systems, components, equipment, and appliances that are changed or significantly affected by the change must comply with the applicable regulations in effect on the date of the application for that change. This requirement would be embodied in proposed § 21.101, which would generally require that an applicant for a change to a type certificate must comply with the regulations in effect on the date of the application for that change, with an exception, however, that those areas, systems, components, equipment, and appliances not affected by significant changes could continue to comply with the regulations incorporated in the reference type certification basis. Accordingly, this proposed amendment would be consistent with the exemptions that have been granted on changes in the

number of engines. The need for requiring a new application for a type certificate would be alleviated in many instances by the proposed changes to § 21.101.

Current § 21.19(c) describes a specific change in which the applicant must apply for a new aircraft engine type certificate. This change is in the principle of operation. Also, current § 21.19(d) describes specific changes in which the applicant must apply for a new propeller type certificate. These changes are in the number of blades or principle of pitch change operation. Invariably, the type of changes set forth in both of these sections are so extensive that a new application would be required in any event because a complete investigation of compliance is required. Accordingly, these types of changes would be deleted from § 21.19 altogether. Under proposed § 21.101, with certain exceptions, these types of changes and all areas, systems, components, equipment, and appliances affected by the changes would have to comply with the regulations in effect on the date of application for the change to the type certificate.

Section 21.101

Current § 21.101(a) states that if a person applies for a change in a type certificate, the product must comply with either the regulations referenced in the type certificate or the applicable regulations in effect on the date of

application for the change plus any other amendments the Administrator finds to be directly related.

Current paragraph (b) addresses novel or unusual design features where the Administrator finds that the regulations incorporated by reference in the type certificate do not provide adequate standards. In this case the applicant must comply with the regulations in effect on the date of the application for the change and any necessary special conditions "to provide a level of safety equal to that established by the regulations incorporated by reference in the type certificate for the product." This means that the level of safety must be at least equal to the level of safety that was required by the regulations referenced in the type certificate.

To ensure that the products meet the latest airworthiness standards wherever possible, proposed § 21.101 specifies that, with certain exceptions, the applicant for a change must comply with the applicable regulations in effect on the date of the application for the change. The intent of this proposal is to apply the applicable regulations in effect on the date of the application to those areas, systems, components, equipment, and appliances affected by the change. For those areas, systems, components, equipment, and appliances not affected by the change, continued compliance with the regulations incorporated by reference in the type certificate is considered acceptable.

Section 21.101(a)

This proposed paragraph requires an applicant for a change to a type certificate to comply with the applicable regulations in effect on the date of the application for the change and with parts 34 and 36.

Section 21.101(b)

This proposed paragraph provides exceptions to the regulation in proposed paragraph (a), permitting the applicant to comply with earlier amendments to the regulations. When choosing the amendment level of a regulation, all related regulations associated with that amendment level should be considered. The amendment level chosen cannot predate either the existing basis or anything required by the retroactive sections, §§ 23.2, 25.2, 27.2, or 29.2. Design changes inevitably vary both in complexity and magnitude so it is necessary for each proposed change to be evaluated on a case by case basis, taking into account previous changes and their certification basis. Individual incremental changes may be modest; however, the cumulative effect can result in a significant overall change. In this context, the following factors should be considered (1) the extent of the previous changes and the extent to which later amendments have been addressed for these individual changes,

and (2) the extent of revisions to the airworthiness standards from those of the original certification basis of the model being changed. When an essentially new product is developed, step by step, through a series of non-substantial design changes, it should achieve a level of safety similar to that of a comparable new product.

Design changes will be classified as either nonsignificant, significant, or substantial. A small weight increase or the installation of a flight management system would not normally be considered a significant change. A change from turboprop to turbofan engines would normally be a significant change. A change from a low wing to a high wing would normally be a substantial change.

Section 21.101(b)(1)

This proposed paragraph provides the first exception to the regulation in proposed paragraph (a), to show compliance with the latest applicable regulations. The proposed paragraph would state that the applicant would be allowed to demonstrate compliance with earlier regulations, but not earlier than the regulations incorporated in the existing certification basis, if the effect of the proposed change is not significant, taking into account earlier design changes and previous updating of the type certification basis.

There may be concurrent significant and non-significant changes made to a product. For example, there may be a

small change in the model of engines used at the same time large changes are made to the airframe. Each part of the total change would be evaluated to determine its significance on its own merit. It must be recognized, however, that a number of related non-significant changes may collectively represent a significant change to the product.

Section 21.101(b)(2)

This proposed paragraph provides the second exception to the regulation in proposed paragraph (a), to show compliance with the latest applicable regulations. The proposed paragraph would state that the applicant may show compliance with earlier regulations for those areas, systems, components, equipment, and appliances that are not affected by the change.

The FAA recognizes that arbitrarily requiring compliance with later regulations in areas, systems, components, equipment, and appliances not affected by the change may cause redesign of components that have an acceptable service record without an attendant improvement in safety, or may have the counterproductive effect of discouraging any changes at all, including those that would provide a significant improvement in safety.

Section 21.101(b)(3)

This proposed paragraph provides the third exception to the regulation in proposed paragraph (a) to show compliance with the latest applicable regulations. If compliance with a regulation in effect on the date of the application for the change would be impractical, or would not contribute materially to the level of safety of the product to be changed, the applicant may demonstrate compliance with an earlier amendment of a regulation for which such compliance would be practical and would contribute materially to the level of safety of the product to be changed, provided that the amended regulation does not precede either the corresponding regulation in §§ 23.2, 25.2, 27.2, or 29.2 of this chapter, or the corresponding regulation incorporated by reference in the type certificate.

Compliance with the later amendment would be considered to "not materially contribute to the level of safety" if the level of safety achieved by the existing design with the proposed design change would not be enhanced by compliance with that later amendment. In demonstrating this, the applicant would show that the level of safety achieved by the existing design incorporating the proposed design change would achieve a safety level commensurate with that reflected in the later amendment.

The factors that would be considered in comparing the level of safety achieved by the existing design incorporating the proposed design change with the level of

safety achieved by compliance with the later amendment would include: whether the product has compensating design features; the extent that the service experience of the product shows that the performance and reliability of the product provides a level of safety commensurate with later amendments; and whether compliance with a later amendment, notably when it necessitates a redesign, would have an adverse affect on the level of safety in terms of performance or reliability.

Nothing would limit the future operation or transfer of a product after a design change is approved with an older certification basis; furthermore, the intent of this proposal is to establish certification bases appropriate to the designs of the products and the design of the changes. Therefore, if an applicant for a design change is changing one or two products, and another applicant is making the same change to 100 of the same product, the applicants' design changes will be certificated to the same basis.

Demonstrating that compliance would not materially contribute to the level of safety could necessitate analyses of the safety features of the existing design and the proposed change, and an analysis of the safety concerns addressed by the relevant amendment. The evaluation may be accomplished using a numerical/statistical approach, subject to the availability and relevance of applicable data. In practice, engineering judgment, based on scientific,

rational, and reasoned analysis of the relevant data, will be used in the development of this evaluation. The essentials of the evaluation would involve:

- a. A clear understanding of the regulatory change and what prompted the change;
- b. A detailed knowledge of the proposed design feature; and
- c. A comprehensive review of the applicable service experience.

In some instances, an applicant may be unable to show that the original certification basis, together with the applicable service experience, provides a level of safety comparable with the later standards. If compliance with the later standards would then involve a design change, the benefits of such a redesign would be considered in the light of any possible adverse effects of the redesign on operation, reliability, durability, etc.

An applicant for a change to a type certificate would not be required to demonstrate that the changed product complies with a later amendment to an airworthiness standard if the applicant shows that such compliance would be "impractical." Compliance with a later amendment would be considered "impractical" when the applicant can establish that the cost of the design change and related changes necessary to demonstrate compliance with the amendment would not be commensurate with the resultant safety benefit.

Where compliance with the later amendment would prompt a redesign, the cost of redesigning other parts of the product to accommodate this redesign would also be considered. A safety/resource evaluation to determine impracticality should be discussed between the applicant and the Administrator. An acceptable evaluation procedure, which compares the cost of achieving and demonstrating compliance with a later amendment with the benefit of the lives, injuries, and hulls that may be saved by such compliance, has been developed and is included in the associated proposed advisory circular.

This assessment, presented in the associated advisory circular, is based on the relationship between the cost and safety benefits of implementing a later airworthiness standard for a change to a type certificated product.

The development of the procedure was based on the transport airplane category because of greater worldwide interest and greater documentation for this category than for other categories. The hazard data used to develop the procedure reflect transport category airplanes used in airline service.

The proposed procedure was developed through a series of iterations attempting to relate the effect of the many revisions of part 25 on safety and the cost of complying with those regulatory revisions. The procedure was adjusted to bring the results into close agreement with the

objectives of this rulemaking. The results of the procedure were verified by using the procedure to analyze selected design changes of transport category airplanes.

The procedure will assist in determining if a later regulatory revision should be implemented for a proposed design change of a type certificated product. The procedure is intended to be used, along with good judgment, by a team of technical experts to evaluate the relative merits of regulatory action governing the type certification of products. This procedure would be applicable to all kinds of products even though the procedure was developed based on experiences in certification of products used in commercial, revenue-producing operations.

Section 21.101(c)

This proposed paragraph contains the provisions of current § 21.101(b)(2) concerning special conditions. For consistency with the other proposed changes to § 21.101, this paragraph states that an applicant for a change must comply with any special conditions, and amendments to those special conditions, if needed, that would provide a level of safety equal to that established by the regulations in effect on the date of the application for the change. The provisions of current § 21.101(b)(1), concerning the use of later regulations when the regulations incorporated by reference do not provide adequate standards with respect to

the proposed change, would no longer be needed and would not be incorporated into the proposed regulation. This is because proposed § 21.101(a) already requires the use of later regulations.

The provisions of current § 21.101(c), concerning the replacement of reciprocating engines with turbopropeller engines, are not incorporated into the proposed regulation. A change of this nature would be considered a significant change, and compliance with the regulations in effect on the date of application for the change, therefore, would be required.

Section 21.101(d)

This proposed paragraph states that an application for a change to a type certificate for a transport category aircraft would be effective for 5 years, and an application for a change to a type certificate for all other products would be effective for 3 years. These proposed effectivity periods for an application are the same as those in current § 21.17(c) and (d) for an application for a type certificate. Because current § 21.101 requires compliance with the regulations incorporated by reference in the type certificate and because the certification basis of the original product doesn't change, having an effectivity period for an application for a design change has not been necessary. Under the proposed § 21.101, which requires

meeting the airworthiness standards in effect on the date of the application for the change, it is necessary to limit the effectivity of the application for a change, to support the intent of the proposed regulation. If an application for a design change expires, this proposed section states that an applicant may file a new application or apply for an extension of the original application.

Unique Aircraft Categories

This section applies to, among others, surplus military aircraft type certificated under current § 21.27.

Airworthiness standards for these aircraft were issued in the 1950's or, where no specific date is listed, the regulations that apply are those that were in effect on the date the first aircraft of the particular model was accepted for operational use by an Armed Force of the United States. These aircraft receive airworthiness certificates in the standard category and, therefore, are eligible to carry persons or property for compensation or hire. The certification basis for changes to these types of aircraft would be established under proposed § 21.101(a).

Limited category aircraft, mostly World War II surplus military aircraft, were issued type certificates based on a satisfactory military safety record rather than on a finding of compliance with any specific civil airworthiness standards. Currently, alterations to limited category

aircraft may be approved based on a showing that the alteration would not detract from the satisfactory military safety record. Operators of limited category aircraft are not permitted to carry persons or property for compensation or hire.

Restricted category aircraft are type certificated for special purpose operations such as aerial application of agricultural fertilizers and pesticides and forest fire retardants. They may be aircraft that comply with the airworthiness standards of another aircraft category except for those regulations that the Administrator finds inappropriate for the special purpose operation, or they may be surplus military aircraft that have been issued type certificates based on a satisfactory military safety record. Operators of restricted category aircraft are not permitted to carry persons or property for compensation or hire.

Surplus military aircraft type certificated in the limited or restricted category normally are not required to comply with an applicable airworthiness standard when they are type certificated, thus permitting these aircraft to have a level of safety different from that required for aircraft that do comply with an applicable airworthiness standard. Therefore, it would be inconsistent to require compliance with later amendments of a regulation for a change when the aircraft may never have met any version of the regulation initially. Requiring these aircraft to

comply with proposed § 21.101(a) would not necessarily enhance the level of safety. However, proposed § 21.101 would be applicable for those changes where the regulations referenced in the type certificate do not provide adequate standards, e.g., installation of a turbopropeller engine in an older agricultural airplane.

Section 21.115

The type certificate holder may obtain approval for a change either by amending the type certificate under § 21.101 or by obtaining a supplemental type certificate under § 21.115. Any other modifier would have to obtain a supplemental type certificate under § 21.115. There should not be a difference in the certification basis for a change to a type certificated product between these two methods of approval, amended type certificate or supplemental type certificate.

Current § 21.115 incorporates the provisions of current § 21.101(a) and (b) by reference, making the provisions of the latter section equally applicable to applicants for supplemental type certificates. In view of the proposed changes to § 21.101, it is necessary to amend § 21.115 to refer simply to § 21.101 rather than specifically to § 21.101(a) and (b). This would not be a substantive change.

Section 25.2

Current § 25.2(c) incorporates the provisions of current §§ 21.101(a)(2) and (b) by reference, addressing the subsequent revisions to the special retroactive regulations. To remain consistent with the proposed changes to § 21.101, it is necessary to amend § 25.2(c) to refer to § 21.101(a). This would not be a substantive change.

International Compatibility

The proposed procedures have been harmonized with the aviation authorities of Canada and Europe. Similar corresponding changes to regulations governing type certification procedures for changed products are being proposed by Transport Canada and the Joint Aviation Authorities.

Regulatory Evaluation, Regulatory Flexibility Determination, and Trade Impact Assessment

Three important requirements pertain to economic impacts of regulatory changes to the Federal Aviation Regulations. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities.

Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this regulation: (1) would generate benefits exceeding costs and is neither major as defined in the Executive Order nor significant as defined in DOT's Policies and Procedures; (2) would not have a significant impact on a substantial number of small entities; and (3) would not have a negative impact on international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

The following discussion of costs and benefits is provided because the proposed procedures would be explicitly incorporated into formal regulations. By administrative policy (Action Notice A8110.23, Procedures for Developing the Type Certification Basis for Derivative Aviation Products), the FAA has obtained agreements that certain changed products would comply with selected amendments that were adopted after the initial application for type certification of the base product. It is likely that such administrative decisions would continue, to some unknown degree for an unknown proportion of type certificated products, in the absence of the proposed regulation.

The proposed regulation would not initiate a specific

certification standard or regulation per se, but instead, would formally alter the manner in which existing and future standards would be determined to be applicable. As a result, the FAA can describe, but is not able to quantify, the costs and benefits of the proposal. A quantification of the impacts would require a forecast of potential future changes to all commuter and transport category airplane models; all rotorcraft; and all other categories of regulated aircraft, aircraft engines, and propellers. In addition, a quantified evaluation would require a review of all applicable regulations that have been adopted during the intervening period after the type certification of the product, plus engineering appraisals of the intended changes for each product, the effects of those changes on other systems and components, and the economics associated with bringing each affected system and component up to the standards of the intervening regulations. No reasonable estimate of these factors can be made.

In addition to the absence of a comprehensive estimate, no examples of such cost estimates are available for this evaluation. In some instances, manufacturers of changed products have complied with later regulations. In association with these actions, individual manufacturers of proposed changed products have evaluated the costs and benefits that would be incurred to meet the pertinent standards. Due to competitive economic considerations,

however, such information is considered proprietary and is not available.

The attributable costs of this proposal are the incremental costs that would be incurred to meet any additional or more stringent standards, adopted after the application for type certification of the initial product, that would not be required in the absence of this proposal. Similarly, the direct benefit of the proposal is the augmented safety that would result from meeting such standards. Although the attributable costs and benefits cannot actually be quantified, certain safeguards have been included in the proposed regulation so that any actions taken pursuant to it would be cost beneficial.

As noted in the description of the proposal, for any proposed change, compliance with later regulations would not be required (1) for a change that is determined not to be significant, (2) for those areas or components not affected by the change, or (3) where compliance with later regulations would be impractical or would not contribute materially to the level of safety. Although a formal cost-benefit analysis is not intended, compliance with later amendments would be considered impractical if the applicant can show that such compliance would result in costs that are not commensurate with the possible safety benefits.

Further guidance on the definition of what constitutes a significant change would be provided in an advisory

circular. The proposed circular would include a procedure for evaluating the practicality of applying later regulations in establishing the certification basis for a changed product. It is intended that the procedure would aid the engineering judgment of a team of technical experts in evaluating the relative merits of applying later regulatory actions. The procedure would compare a safety index to a resource index to determine whether a particular changed product should comply with later regulatory changes.

The safety index would measure: (1) the seriousness of the consequences of the hazard that the later regulations address, (2) the projected frequency of those consequences, and (3) the expected incremental effectiveness of the later standards in addressing this hazard for the changed product in question. The resource index would gauge: (1) the incremental labor and capital equipment necessary for compliance, (2) the effect on scrap parts and part interchangeability, and (3) the potential increase in operating costs or reduction in revenue or utility.

In addition to the benefits of any individual action taken pursuant to the proposed regulation, the proposal would also generate procedural benefits. The formalization of this policy by regulation would expedite decisions about the certification basis of proposed changed products and, therefore, would provide manufacturers and modifiers with earlier and more dependable information on which to base

their product development decisions. In addition, the proposed procedures have been harmonized with the aviation authorities of Canada and Europe and the resulting common standards would reduce the costs and delays necessary to formally determine and fulfill dissimilar international requirements.

Although the attributable costs and benefits of the proposed regulation cannot be quantified, the FAA believes that it would be cost beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by Government regulations. The RFA requires a Regulatory Flexibility Analysis if a proposed regulation would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, establishes threshold cost values and small entity size standards for complying with RFA review requirements in FAA rulemaking actions. The proposed amendments would not have a significant economic impact on a substantial number of small entities.

Trade Impact Assessment

The proposed regulation would not constitute a barrier to international trade, including the export of American goods and services to foreign countries and the import of foreign goods and services into the United States. Instead, the proposed type certification procedures for changed products have been harmonized with those of foreign aviation authorities and would lessen the restraints on trade.

Federalism Implications

The regulations proposed herein will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

For the reasons discussed in the preamble, and based on the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the FAA has determined that this proposed regulation is not a significant regulatory action under Executive Order 12866. In addition, the FAA certifies that this proposal, if adopted, will not have a significant economic impact,

positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This proposal is considered nonsignificant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). An initial regulatory evaluation of the proposal, including a Regulatory Flexibility Determination and International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under "FOR FURTHER INFORMATION CONTACT."

List of Subjects

14 CFR part 11

Administrative practice and procedure reporting

14 CFR part 21

Aircraft, Aviation safety, Safety, Type certification

14 CFR 25

Aircraft, Aviation safety, Safety, Type certification

The Proposed Amendments

Accordingly, the FAA proposes to amend 14 CFR parts 11, 21, and 25 as follows:

PART 11 -- GENERAL RULE-MAKING PROCEDURES

1. The authority citation for part 11 continues to read as follows:

Authority: 49 U.S.C. app. 1341(a), 1343(d), 1348, 1354(a), 1401 through 1405, 1421 through 1431, 1481, 1502;

49 U.S.C. 106(g).

2. The first sentence of § 11.11 is revised to read as follows:

§ 11.11 Docket.

Official FAA records relating to rulemaking actions, including: (a) Proposals, (b) notices of proposed rulemaking, (c) written material received in response to notices, (d) petitions for rulemaking and exemptions, (e) written material received in response to summaries of petitions for rulemaking and exemptions, (f) petitions for rehearing or reconsideration, (g) petitions for modification or revocation, (h) notices denying petitions for rulemaking, (i) notices granting or denying exemptions, (j) summaries required to be published under § 11.27, (k) special conditions required as prescribed under §§ 21.16 or 21.101(c), (l) written material received in response to published special conditions, (m) reports of proceedings conducted under § 11.47, (n) notices denying proposals, and (o) final rules or orders are maintained in current docket form in the Office of the Chief Counsel. * * *

PART 21 -- CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

3. The authority citation for part 21 continues to read as follows:

Authority: 49 U.S.C. 1344, 1348(c), 1352, 1354(a),

1355, 1421 through 1431, 1502, 1651(b)(2), 42 U.S.C. 7572; E.O. 11514; 49 U.S.C. 106(g) [Revised Pub. L. 97-449, January 12, 1983.]

4. Section 21.19 is revised to read as follows:

§ 21.19 Changes requiring a new type certificate.

Any person who proposes to change a product must apply for a new type certificate if the Administrator finds that the proposed change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

5. Section 21.101 is revised to read as follows:

§ 21.101 Designation of applicable regulations.

(a) Except as provided in paragraph (b) of this section, an applicant for a change to a type certificate must show that the changed product complies with:

(1) Each regulation in parts 23, 25, 27, 29, 31, 33, and 35 of this chapter that applies to the changed product and that is in effect on the date of the application for the change; and

(2) Parts 34 and 36 of this chapter.

(b) The applicant may show that the changed product complies with an earlier amendment of a regulation required by paragraph (a)(1) of this section, and any other regulation the Administrator finds is directly related,

provided that the amended regulation does not precede either the corresponding regulation in §§ 23.2, 25.2, 27.2, or 29.2, of this chapter, or the corresponding regulation incorporated by reference in the type certificate:

(1) For a change the effect of which, combined with all previous relevant changes, the Administrator finds is nonsignificant;

(2) For each area, system, component, equipment, or appliance that the Administrator finds is not affected by the change; and

(3) For each area, system, component, equipment, or appliance that is affected by the change, if the Administrator also finds that compliance with a regulation described in paragraph (a)(1) of this section would be impractical or would not contribute materially to the level of safety of the changed product.

(c) If the Administrator finds that the regulations in effect on the date of the application for the change do not provide adequate standards with respect to the proposed change because of a novel or unusual design feature, the applicant must also comply with any special conditions, and amendments to those special conditions, prescribed under the provisions of § 21.16, to provide a level of safety equal to that established by the regulations in effect on the date of the application for the change.

(d) An application for a change to a type certificate for

a transport category aircraft is effective for 5 years, and an application for a change to any other type certificate is effective for 3 years. If the change has not been approved, or it is clear that it will not be approved under the time limit established under this paragraph, the applicant may --

(1) File a new application for a change to the type certificate and comply with all the provisions of paragraph (a) of this section applicable to an original application for a change; or

(2) File for an extension of the original application and comply with the provisions of paragraph (a) of this section for an effective date of application, to be selected by the applicant, not earlier than the date which precedes the date of approval of the change by the time period established under this paragraph for the original application for the change.

6. Paragraph (a) of § 21.115 is revised to read as follows:
§ 21.115 Applicable requirements.

(a) Each applicant for a supplemental type certificate must show that the altered product meets applicable requirements specified in § 21.101 and, in the case of an acoustical change described in § 21.93(b), show compliance with the applicable noise requirements of part 36 of this chapter and, in the case of an emissions change described in § 21.93(c), show compliance with the applicable fuel venting

and exhaust emissions requirements of part 34 of this chapter.

* * * * *

PART 25 -- AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY

AIRPLANES 7. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(G) (Revised Pub. L. 97-449, January 12, 1983).

8. Paragraph (c) of § 25.2 is revised to read as follows:

§ 25.2 Special retroactive requirements.

* * * * *

(c) Compliance with subsequent revisions to the sections specified in paragraph (a) or (b) above may be elected or may be required in accordance with § 21.101(a) of this chapter.

Issued in Washington, DC, on

- F I N A L D R A F T F I V E -
(August 24, 1994)

Subject: **ADVISORY MATERIAL FOR ESTABLISHING THE
 CERTIFICATION BASIS OF CHANGED AERONAUTICAL
 PRODUCTS**

1. PURPOSE. This advisory circular (AC) provides guidance for determining the certification basis for changed aeronautical products, including identifying the conditions under which it will be necessary to apply for a new type certificate. The AC explains how an applicant may show that compliance with the later regulations would be impractical or would not contribute materially to the level of safety. An applicant may also make showings of impracticality or not contributing materially to the level of safety without using this AC. This AC and the methods illustrated in the appendices to it are guidance material. Each project must be judged on its own merits when making the final determination of impracticality or not contributing materially to the level of safety.

2. EFFECTIVE DATE.

3. RELATED FAR SECTIONS. Part 21, § 21.17, Designation of applicable regulations, § 21.19, Changes requiring a new type certificate, § 21.93, Classification of changes in type designation, § 21.101, Designation of applicable regulations, and § 21.115, Applicable requirements.

4. APPENDICES. The appendices in this AC present further explanation and examples of certain terms used in the AC. The examples contained in the appendices are intended to provide guidance and should not be interpreted as specific constraints. Later changes to the standards may affect the validity of some of the examples.

Appendix 1 - Classification of Changes/Examples.

Appendix 2 - Procedure for Evaluating Later Rules in
 Establishing the Certification Basis for a Changed
 Product.

Appendix 3 - Use of Service Experience in Establishing the
 Certification Basis for a Changed Product.

5. EXPLANATION OF TERMS. The following is an explanation of the terms used throughout this advisory material.

 a. **Design** - includes construction and construction material, aerodynamic configuration, number and location of engines, velocity, type or principle of propulsion (for aircraft), and principle of control (for aircraft, engines and propellers).

b. **Earlier Regulations** - the regulations prior to those in effect at the time of the application for the change.

c. **Extent of a change** - the extent of a change is considered relative to the original model, taking into account any relevant design changes for which either the certification basis has already been updated from that of the original type certificate, or the certification basis could be updated without further changes being incorporated. The extent of a change is assessed on the scope of the design changes in combination with the amount of certification effort required to establish compliance with the applicable requirements.

d. **Impractical** - compliance with the regulations in effect at the time of the application for a change may be considered impractical if the applicant can show that it results in costs that are not consistent with the change for which application has been made and with the safety benefits that result from demonstrating compliance with the later regulations.

e. **Later Regulations** - the regulations in effect at the time of the application for the change.

f. **Non-significant Change** - a design change the extent of which is not enough to require any change in the regulations in the certification basis.

g. **Not contribute materially to the level of safety** - The inclusion of a later regulation in the certification basis would be considered not to contribute materially to the level of safety if the level of safety achieved by the existing design with the proposed design change would not be enhanced by compliance with the later regulation.

h. **Significant Change** - a design change the extent of which is enough to require the inclusion of later regulations in the certification basis, but not to require a new type certificate.

i. **Substantial Change** - a design change the extent of which would require a new type certificate and consequently a certification basis that includes all of the regulations in effect at the time of application for the change.

Appendix 1 presents further explanation of these terms along with some illustrative examples. The examples contained in the appendix are intended to provide guidance and should not be interpreted as specific constraints. It is recognized that later changes to the regulations may effect the validity of some of the examples.

6. BACKGROUND. Sections 21.17, 21.19 and 21.101 establish the type certification regulations for which compliance must be shown for changed products. Section 21.19 establishes if a new type certificate is required for a changed product. If a new type certificate is required, § 21.17 specifies the applicable certification basis for the changed product. When a new application is not required by § 21.19, § 21.101 specifies the applicable certification basis for the changed product. These sections as previously written have led to widely varying interpretations of when a new type certificate is required. Section 21.101, as amended by Amendment 21-XX, requires changed products to comply with regulations in effect on the date of application for the change in all areas affected by the change, unless the applicant justifies the use of earlier regulations.

7. GENERAL. Design changes inevitably vary in both complexity and magnitude so it is necessary for each proposed changed product to be evaluated on a case by case basis, taking into account previous models and their certification bases. Individual incremental updates may be modest, however the cumulative effect can result in a substantial overall model change. In this context the following factors need to be considered: (1) the extent of changes to the regulations from those of the original certification basis, and (2) the extent to which later amendments have been addressed for previous model changes. The intention is to ensure that when an essentially new product is developed, step by step, through a series of non-substantial design changes, that it achieves a level of safety similar to that of a comparable new product.

8. CHANGES REQUIRING A NEW TYPE CERTIFICATE (§ 21.19).

a. General Section 21.19 requires that an applicant obtain a new type certificate for a changed product if the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required. A new type certificate could be required for either an extensive change to a previously type certificated product or for an essentially new design derived from a previously type certificated product. The need to require a new type certificate may be obvious when the change is first considered or only after careful consideration of many factors and the use of appropriate evaluation methods and sound engineering judgement. The overall extent of the change to the previously type certificated product(s) is the primary factor to review. To determine the extent of the change the amount of certification work required needs to be considered in addition to the extent of the change to the design. It is anticipated that § 21.19 would normally only come into effect where it has not been possible to agree a certification basis under § 21.101.

b. Objective of § 21.19 The objective of § 21.19 is to ensure that an extensive change to a previously type certificated product is certificated to the appropriate level of safety. This includes establishment of the applicable regulations. A "substantially complete investigation" of compliance is required when most of the existing justification is not applicable to the changed product. This applies to the scope of the investigation required to establish compliance. For example, an extensive change may negate the validity of extrapolation or use of certain analysis or tests that were used to show compliance of the original or previously type certificated product. Appendix 1 provides examples of changes that may fall under this category.

9. DESIGNATION OF THE APPLICABLE REGULATIONS (§ 21.101).

a. General Section 21.101 defines the Procedures for establishment of the certification basis for changed products. It should be noted that minor changes, as defined in § 21.93, have no appreciable effect on the airworthiness of the product and would therefore allow compliance with the regulations incorporated by reference in the type certificate.

b. Objective of § 21.101 (a) The intention of § 21.101(a) is to enhance safety through the incorporation of later regulations in the certification basis of changed products. Section 21.101(a) requires that any change to any type certificated product must comply with the applicable requirements at the date of application. Section 21.101(a) allows for the exceptions identified in § 21.101(b) and the application of Special Conditions in accordance with § 21.101(c). The certification basis for a changed product will depend only on the extent of the change. It should not be a function of either the origin of the change, i.e. the type certificate holder versus an applicant for a supplemental type certificate, or the effectivity of the change, i.e. in production versus in service.

c. Objective of § 21.101 (b).

(1) General. Section 21.101(b) identifies conditions under which an applicant may show that the changed product complies with an earlier amendment or with the regulation incorporated by reference in the type certificate and, therefore, does not have to comply with the regulations in effect on the date of application. The earlier amendment with which the applicant intends to show compliance may not precede either the corresponding regulation in §§ 23.2, 25.2, 27.2, or 29.2 or the corresponding regulation incorporated by reference in the type certificate. An applicant may elect to show compliance with an earlier amendment or with the regulation incorporated by reference in the type certificate for non-significant changes, areas not affected by the change, and areas affected by the change for which compliance with the standards in effect on the date of application would be impractical or would not contribute materially to the level of safety.

(2) **Non-significant Changes, § 21.101 (b)(1).** Not all changes are significant changes. Those changes not considered to be significant can be certificated in accordance with earlier regulations, which in this case are those incorporated by reference in the type certificate. Included in this category are changes that do not modify the general characteristics of the product in that: (1) The general configuration and the principles of construction are retained; and (2) The assumptions used for certification of the basic product remain valid and the results can be extrapolated to cover the changed product. Appendix 1 provides examples of non-significant changes.

(3) **Unaffected Areas, 21.101 (b)(2).** In areas not affected by the change the applicant may use earlier regulations, but it is important that the effects of the change are properly assessed. The characteristics affected by the change are not only physical changes. In fact the intent is to encompass all matters where there is a need for re-certification, that is where the substantiation presented for the model being changed needs to be reviewed, updated or re-written.

(a) **Physical aspect.** The physical aspect is covered by the words systems, equipments, components and appliances (physical aspects can cover both "hardware" and "software"). Within the physical aspect it is necessary to make a distinction between the principal changes such as a fuselage plug and the secondary changes such as lengthening of the various airplane circuits as a result of the fuselage plug (this would also apply to additional seats, overhead bins, etc...). Identified secondary changes normally can be considered as unaffected areas, although care should be exercised to avoid being too simplistic. For example, the installation of significantly more powerful engines means that the aircraft rotor burst model is likely to be changed. Therefore new requirements relative to this issue would need to be considered.

(b) **Effects on characteristics.** The less obvious aspect is covered by the word "areas". This covers general characteristics of the airplane such as performance, handling qualities, emergency provisions, fire protection, structural integrity, crashworthiness, etc. These characteristics may also be affected by a change: for example adding a fuselage plug could significantly impact performance and handling qualities.

(4) **Impractical or would not contribute materially to the level of safety, 21.101 (b)(3).** It is acceptable to show that demonstrating compliance with a particular amendment level does not contribute materially to the level of safety. Demonstrating that compliance with a particular amendment level is impractical also requires consideration of the potential safety benefits.

(a) **Impractical.** Compliance could be considered impractical if the applicant can show that the demonstration of compliance with the later regulations would result in costs that are not commensurate both with the possible benefits associated with the change for which application has been made and with the enhanced safety level that results from the application of the later regulations. The additional costs could include those arising from either design changes required to show compliance or the effort required to demonstrate compliance.

Appendix 2 provides an evaluation method that can be used to assess the effectiveness of applying a regulation at a particular amendment to a changed product. The evaluation method presented should not be used in isolation, but as one element of the overall evaluation.

(b) **Not contributing materially to the level of safety.** Compliance could be considered not to contribute materially to the level of safety when an applicant can show that the design has compensating features, that relevant experience shows such compliance is unnecessary or that compliance may compromise the existing level of safety. This exception could be applicable in the situations described in the paragraphs below.

1. Consistency of design requirements. The provision gives the opportunity to consider the consistency of design requirements. For example, when a fuselage plug is added, additional seats and overhead bins are likely to be installed. An additional door and an extended the lower cargo hold may also be incorporated. These additional seats, bins, door and lower deck cargo hold may be identical to the existing ones. The structural plug may also be identical to the existing structure. Literally applying the new requirements only to the changed parts may not contribute materially to the level of safety, as the entire design as modified may not necessarily be any better than the unmodified design. In such a case the use of the earlier regulations should be permitted.

2. Service experience. The provision also permits the use of relevant service experience to justify the use of the original certification basis. The rationale is that a level of safety comparable to the later rule can be demonstrated by service experience, in combination with the safety level provided by the regulations incorporated by reference in the type certificate. An acceptable method that provides guidelines on the types of information that should be considered, together with an example, is presented in Appendix 3.

3. Other exceptions. Compliance with amended regulations would normally not be required where the amendment has been made only to correct, consolidate or clarify the text of an existing regulation.

The application of later regulations to aircraft certificated in, or being certificated in, the restricted category would normally not be

considered to contribute materially to the level of safety. Where the regulations incorporated by reference in the type certificate do not provide appropriate regulations the application of the later regulations would normally be considered to contribute materially to the level of safety. For example, the installation of turbopropeller engines in lieu of reciprocating engines either in an aircraft that was originally certificated based on satisfactory military service experience, or in an aircraft for which the original certification basis did not contain regulations for turbine engine installations. As provided by §21.25, it would not be necessary to comply with those regulations found inappropriate for the specific purpose for which the aircraft is being certificated in the restricted category. Similar considerations may be applicable to other unusual aircraft categories.

(5) Substantial Changes, § 21.19. Changes which require a substantially complete investigation of compliance must be certificated to the applicable regulations as specified in § 21.17, in accordance with § 21.19. If it is not initially clear that a new type certificate is required, following the logic of the flowchart in Figure 1 may help to clarify whether or not one is needed. In particular the evaluation of the affected areas may show that a design change thought to be significant is in fact a substantial one.

(6) Special Conditions, § 21.101(c). As required by § 21.16 for new Type Certificates, § 21.101(c) allows for the application of Special Conditions, or for changes to existing Special Conditions, to address the changed design. The objective is to achieve, for the changed product, a level of safety consistent with that provided by the regulations in effect on the date of application for the design change. The application of Special Conditions to a design change is not in itself a reason for it to be classified as either a substantial change or a significant change.

(7) Effective period for an application to change a Type Certificate, § 21.101(d). Section 21.101(d) is intended to ensure that, at the time the changed product is certificated, the latest rules in the certification basis are not more than five or three years out of date, as applicable.

10. METHODOLOGY FOR ESTABLISHING THE CERTIFICATION BASIS. Figure 1 presents the overall methodology in a flowchart that shows the various aspects of § 21.101 as explained in this advisory material. The certification basis is determined through negotiation between the applicant and the FAA, in an iterative manner if necessary. The rationale and the agreed certification basis is recorded on the Issue paper. The agreed certification basis for each significant change will be presented on the Type Certification Data Sheet.

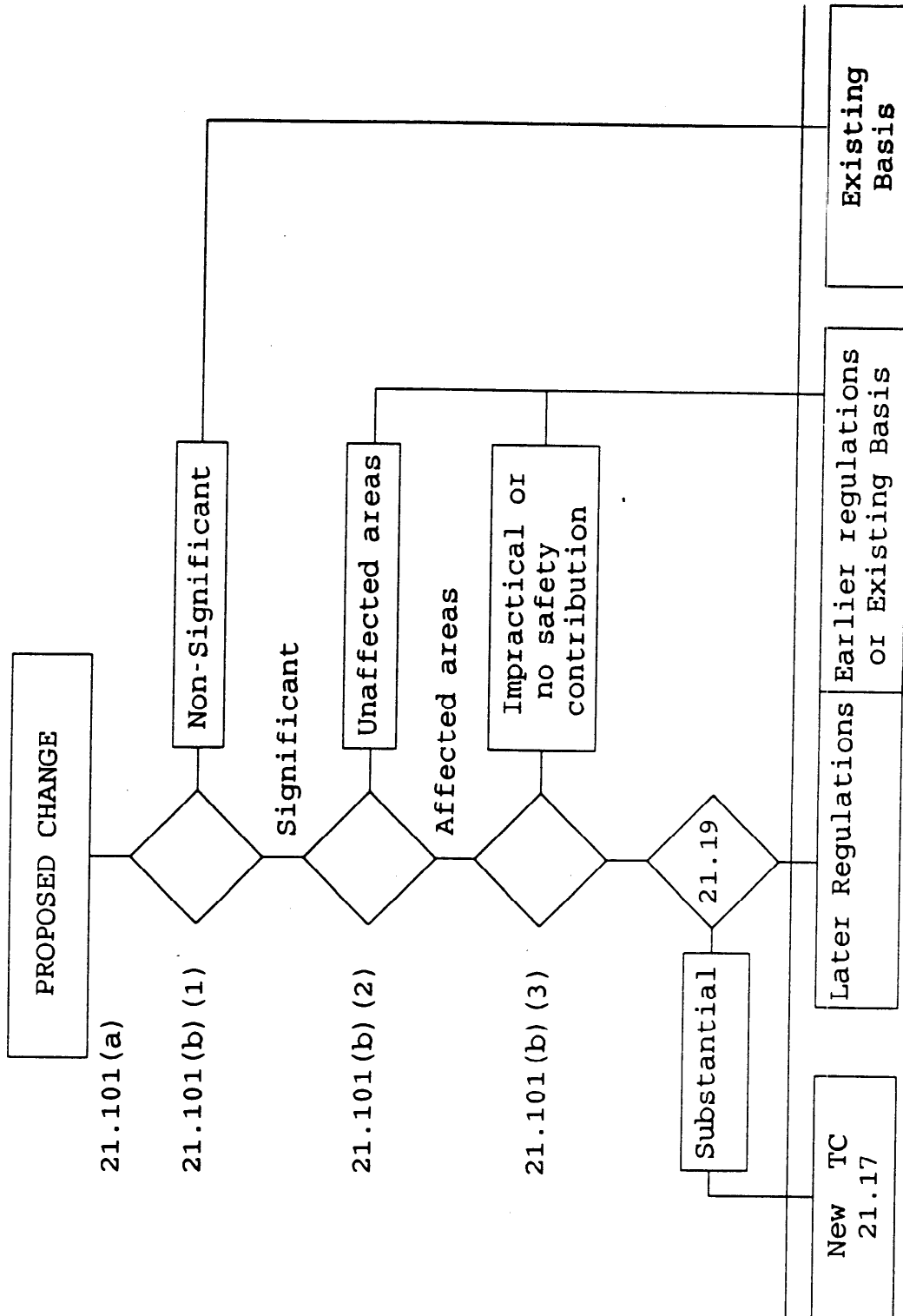
Notes on Figure 1:

§ 21.101(b) allows the applicant to comply with the later regulations for a non-significant change, but it is not anticipated that the certification basis would normally be updated for a non-significant change. Figure 1 is simplified to show the normal case of using the existing basis for non-significant changes.

The term 'Existing Basis' is used to denote the regulations incorporated by reference in the type certificate.

Figure 1

ESTABLISHMENT OF THE CERTIFICATION BASIS FOR CHANGED PRODUCTS



Appendix 1 - CLASSIFICATION OF CHANGES/EXAMPLES

1. **INTRODUCTION** This Appendix is provided to assist in deciding what might be regarded as a **substantially, significantly or non-significantly** changed product as defined in paragraph 3 of the main text of this Advisory Circular. As part of this process it is recommended that each design change should initially be evaluated separately to determine its individual importance in relation to the product as a whole. After this first evaluation, the various design changes should be considered in combination, not only in isolation. In each situation the extent of the changes needs to be considered in relation to previous models, taking into account the certification background of the whole series to help determine the applicability of 21.19 or 21.101 to the changed product. Note that the Appendix headings are related to the changes themselves rather than the perceived extent of those changes. The terms "normally" and "typically" are used to indicate that judgement is required for particular cases.

2. AIRPLANES

a. Airframe Changes Typically the following design changes alone could be regarded as being **substantial**:

- Change from high wing to low wing, or vice versa
- Change of empennage configuration for larger airplanes (cruciform vs 'T' or 'V' tail)
- Complete repositioning of engines (tail to wing, etc)

Alternatively, in isolation, the following design changes could typically be regarded as **significant** rather than **substantial**:

- Fuselage length change
- Fuselage diameter change
- A design change that appreciably affects the characteristics of the primary load bearing structure.
- Change to wing sweepback of less than approximately 10 degrees
- Undercarriage configuration:
 - retractable vs fixed
 - tailwheel vs tricycle
 - installation of skis/floats

- The introduction of a cargo door on an existing aircraft
- The introduction of a cabin pressurisation system.
- A design change that appreciably alters structural crashworthiness features.

b. Principles of Propulsion A change in the principle of propulsion from either a reciprocating or turbopropeller engine to a turbojet will normally be regarded as **substantial** and require a new TC. This will typically be due to the different air mass flow effects on the aircraft; for example, propeller slip-stream benefits on elevator effectiveness in critical flight conditions.

c. Engines and Propellers Here the complexity which results from design change(s) need to be considered very carefully when coming to a conclusion as to whether the change is **substantial** or **significant**. When there is a reduction in the number of engines on an airplane, say from 3 to 2 and the related changes are small, a new TC is unlikely to be required. Similarly, a new type certificate would not be required for a change to replace reciprocating engines with the same number of turbo-propeller engines. On the other hand increased airplane complexity will generally result from an increase in the number of engines, particularly from one engine to two, and hence will normally be regarded as a **substantial** design change. Finally, the installation of an alternate engine using the same principles of operation that does not greatly alter power limitations and which has a minimum number of installation changes would be regarded as **non-significant**.

d. Materials Use of new types of material, such as composites, for primary structure would normally be assessed as a **significant** change.

e. Weight A maximum take-off weight (MTOW) increase of more than 50% would normally be regarded as being a **substantial** change.

A MTOW increase of less than 20% by itself, would not normally be considered to be more than **significant**. An increase of less than 5% is likely to be regarded as being **non-significant**.

f. Power or Thrust An overall power/thrust increase of more than 50% would normally be regarded as being a **substantial** change, whereas an increase of less than 20%, by itself, would not be considered to be greater than **significant**. An increase of less than 5% is likely to be regarded as being **non-significant**.

(1) If the change involves fewer engines, the change in power or thrust at a particular engine location should also be considered as well as the change in total power or thrust.

(2) If the additional power is simply used to enhance high altitude or hot day performance then the change is likely to be **non-significant**.

Note: Weight and power/thrust variables (paragraphs 2(e) and (f)) are obviously interrelated and should be referenced back to the original model (see also paragraph 1 of this Appendix).

g. Systems As a general guide classification as **substantial/significant** will depend upon:

- airplane capability enhancement
- new technologies employed
- certification basis of airplane

(1) **Flight Controls** A change in the flight control concept for an aircraft, for example to fly by wire (FBW) and side-stick, would in isolation normally be regarded as a **significant** change.

(2) **Avionics** Examples of individual **significant** avionic changes are:

- A major flight deck update
- Installation of avionic equipment where operational credit is to be taken for its presence in an aircraft. For example, a Head Up Display.
- Introduction of autoland.

Non-significant items might include:

- A general avionic equipment change, including installation of a new system such as GPS for information purposes, where no credit is taken for it as an aid.
- An alternate autopilot.

(3) **Brakes** An alternate type of wheel brakes would be regarded as being **non-significant**.

h. Cabin The most prominent changes are likely to be those which have an adverse effect on the emergency egress capability of an airplane; for example, types and number of emergency exits, increase in passenger capacity, etc. Changes of this nature would usually be regarded as **significant** design changes.

i. **Flight Crew** A reduction in flight crew numbers which necessitates a complete cockpit re-arrangement and/or an increase in pilot workload would amount to a **significant** change.

j. **Operating Envelope/Capability** Any marked expansion of an aircraft's operating envelope or operating capability, for example the following items, would normally be seen as **significant** changes:

- An increase in maximum altitude to above 41,000 ft.
- Approval for flight in known icing conditions.

k. **APU Installation** Typically the introduction of an APU installation would be categorised as a **significant** change.

3. **ROTORCRAFT** The same general principles outlined in paragraph 2 above would also apply to rotorcraft. Additionally:

- A change to the number of main rotors would be considered as a **substantial** change.
- A change to the number of main rotor blades, the nature of the blades, or the method of control, would normally be individually be regarded as **significant**. In combination they may well warrant a **substantial** classification.
- Changes in the principles of directional control (e.g. tail rotor to ducted air) would be regarded as **significant**. Other changes, such as the use of exhaust to unload the tail rotor, would be considered **non-significant**.
- A change which involves the introduction of a twin engine installation in place of a single engine would normally be classified as **significant**.

4. **ENGINES** In addition to the general points included in paragraphs 2 and 3 above, the following items highlight specific topics which should be considered in relation to engine type certification:

a. **Turbine Engines**

(1) **Rotor Stages** Unless associated with a marked corresponding increase in power or thrust (>30%), a change to the number of compressor or turbine stages would normally be regarded as a **significant**, rather than **substantial**, design change. An exception might be the addition of a fan stage to an existing turbomachine.

(2) **Fixed Turbine vs Free-turbine in a Shaft Output Engine** A change of this nature would normally necessitate other **significant** modifications (engine control modes and systems, additional shafts and bearings, lubrication system changes etc.) the combination of which is

likely to be regarded as a **substantial** design change package.

(3) **Fuel Control System** A change to the fuel control system type would only be considered **significant** if it required a major reassessment of the engine and control system failure analysis, or in the case of an engine already approved for ETOPS the reliability analysis. Thus a change from one hydromechanical design to another would normally be **non-significant**, since although the FMEA would need to be redone there is no fundamental philosophical change, whereas to go from a hydromechanical to a dual channel FADEC with no manual back-up would almost certainly be **significant**. Calibration adjustments and the provision of various limits to suit specific aircraft installations within the existing engine approval are **non-significant**.

(4) **Structural Design Changes** There are design changes which appear to be almost **non-significant** but which in reality are **significant**. This is when the change is in the engine structure or basic mechanical design but is not readily apparent. A good example is when a separately bladed fan is replaced by an integral unit. This would require a reassessment of bird ingestion capability at the very least. A structural design change between integral and built-up rotor stages might be considered as **significant**.

b. Reciprocating Engines

(1) **Number of Cylinders** A change to the number of cylinders would normally be considered as **substantial**.

(2) **Principle of Operation** Conversion from spark ignition to compression ignition would normally be regarded as a **substantial** change, because of the major changes in component strength required by the mode of operation.

(3) **Supercharging** Supercharging by either mechanical or exhaust-driven means will not normally be regarded as a **substantial** change where the feature is used to enhance hot day or high altitude performance. For example, the addition of a turbocharger should not have a marked effect unless a dramatic increase in (sea level, standard day) power is sought. If however the objective is a large increase in power (see also paragraph 4(a)), the change might be classified as **substantial**.

(4) **Fuel Control System** Changes in the fuel control system, such as float carburettor to pressure carburettor, carburettor to fuel injection, electronic fuel controls (FADEC), etc., would be considered **non-significant**.

5. **PROPELLERS** Changes to propellers, such as minor variations in diameter, pitch, airfoil or planform, or the addition of de-icing boots, would normally be regarded as **non-significant**. Changes that are likely to have a marked effect on the integrity of the blades or the blade retention system, such as replacing metal blades with blades

of composite construction or introducing different principles of blade retention, would generally be considered as **significant**. A change in the number of blades would normally be considered as a **substantial** change.

6. OTHER TYPE CERTIFICATED PRODUCTS The principles already described in paragraphs 2 through 5 above should also be related to other aeronautical products, as appropriate. These would include airships, balloons, etc.

Appendix 2 - PROCEDURE FOR EVALUATING LATER RULES IN ESTABLISHING THE CERTIFICATION BASIS FOR A CHANGED PRODUCT

1. **INTRODUCTION** This Appendix provides procedural guidance for evaluating the safety benefit/resource impact of implementing later airworthiness regulations in the certification basis of a changed product. (ref: FAR 21.101) The procedure is intended to be used, along with good judgement, by a team of technical experts to evaluate the relative merits of regulatory action governing aircraft and components thereof. The procedure combines a SAFETY INDEX with a RESOURCE INDEX to determine if a particular regulatory change should be implemented.

The SAFETY INDEX is a function of:

- the seriousness of the consequences of the hazard that regulatory change addresses,
- the frequency of those consequences, and
- the effectiveness of applying to the changed product the regulatory change intended to address this hazard.

The RESOURCE INDEX is a function of:

- The extent of labour required to implement the regulatory change in the time allowed.
- The extend of new capital equipment needed,
- The impact on scrap, part interchangeability, and the need for new aircraft equipment,
- The potential increase in operating cost, and
- The revenue/utility loss resulting from the implementation of the regulatory change.

A SAFETY/RESOURCE EVALUATION GUIDE has been developed as a tool to aid in accomplishing the procedure.

2. **INSTRUCTIONS**

a. The following steps are required to use the upper portion of the SAFETY/RESOURCE EVALUATION GUIDE and should be read in conjunction with the example in section 3.0.

(1) Identify the regulatory change being evaluated.

(2) Identify the specific hazard that the regulatory change addressed.

(3) Review history of the consequences of the hazard that led to the regulatory change - i.e.

- caused injuries and/or
- resulted in a hull loss but no deaths and/or
- resulted in the deaths of less than 10% of the people on board and/or
- resulted in the deaths of more than 10% of the people on board

Note: a hazard may have had more than one of these consequences.

(4) The results of the history review for each consequence are plotted as shown on the upper left hand quadrant of the chart.

(5) The "longest" vector is transferred to the upper right hand quadrant of the chart and an estimate made of the effectiveness of the regulatory change.

The effectiveness of an action is a direct function of the precision of the hazard statement in step 2.a.(2) and of the design features of the changed product.

Table 2.1, Descriptions for Effectiveness of Actions, describes the subjective judgements of the effectiveness of the regulatory change.

b. The lower left part of the SAFETY/RESOURCE EVALUATION GUIDE provides a method to determine the economic effect of the action proposed to comply with the regulatory change. It is not intended to be a detailed cost benefit study, but rather to determine if the regulatory change should be implemented. This is accomplished by determining the impact of the proposed action on each of five resource categories. The categories are Labor, Capital, Material, Operating Cost and Revenue/Utility Loss. In any category an assessment value of 1 point signifies negligible expenditure of resource to accomplish the action. An assessment of 100 points signifies an action that may not be economically reasonable, technically practical, or achievable.

(1) Assess each of the categories as defined in the Resource Definitions, Table 2.2. This table also gives a description of the scope of each of the categories.

(2) The RESOURCE INDEX for a proposed action is a result of adding the points from each of the five resource categories.

c. The SAFETY INDEX and RESOURCE INDEX are then combined on the lower right hand quadrant of the SAFETY/RESOURCE EVALUATION GUIDE to determine if the proposed action is appropriate. If the evaluation of the proposed action clearly falls on the "EFFECTIVE" side of the graph, the amendment considered should be incorporated into the certification basis in accordance with FAR 21.101(a).

3. EXAMPLE Figure 2.1 illustrates the use of the SAFETY/RESOURCE EVALUATION GUIDE for an unspecified hazard. Figure 2.2 provides a blank SAFETY/RESOURCE EVALUATION GUIDE.

Table 2.1 - DESCRIPTIONS FOR EFFECTIVENESS OF ACTIONS

Level I	Eliminates hazard or allows hazard to be completely avoided.	Action is fully effective in all cases.
Level II	Considerable potential for eliminating or avoiding the hazard.	Action is fully effective in all probable or likely cases, but does not cover all situations or scenarios.
Level III	Adequately deals with the hazard.	Action is fully effective in many cases, but does not cover all probable or likely cases. Usually this action only addresses a significant part of a larger or broader hazard.
Level IV	Hazard only partly addressed.	Action is partly effective in some cases, but does not cover all probable or likely cases. Usually this action only addresses part of a hazard.
Level V	Hazard only partly addressed but action has negative side effect.	Action is of questionable benefit.

Terms used in Table 2.2

Labor is work carried out in the design, fabrication, inspection, operation or maintenance of an aircraft for the purpose of incorporating or demonstrating compliance with a proposed action. Non-recurring and recurring labor requirements, including training, will be considered.

Capital is construction of new, modified or temporary facilities for design, production, tooling, training or maintenance.

Material is costs associated with product materials, product components, inventory, kits and spares.

Operating Costs are only associated with fuel, oil, fees and expendables (such as de-icing fluids).

Revenue/Utility Loss results from earning/usage capability reductions from departure delays, product downtime, capability reductions or performance loss due to seats, cargo, range or airport restrictions.

Table 2.2 - RESOURCE DEFINITIONS

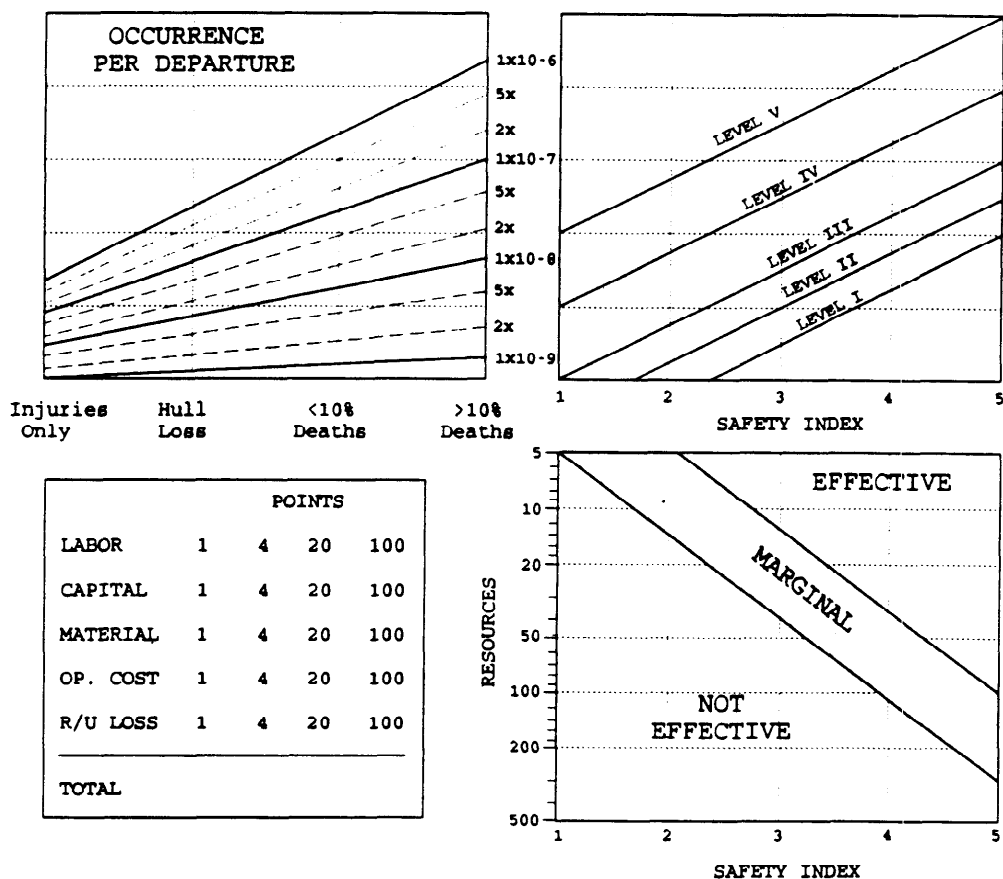
	1 Point	4 Points	20 Points	100 Points
Labor	Negligible increase in man hours required.	Increase in man hours required. Basic labor requirement may be accomplished by existing workforce.	Significant increase in man hours required, resulting in an increased workforce.	Substantial increase in man hours, requiring a workforce that may not be available.
Capital	No requirement for any new or modified facilities or capital equipment.	Requires minor modification to existing facilities or equipment. Minor investment in equipment may be required.	Requires minor investment in new facilities or significant modification of existing facilities, or significant investment in equipment.	Requires substantial investment in new or modified facilities or equipment.
Materials	Negligible effect on product components, interchangeability or rework.	Minor design or construction changes which may result in reworking existing components. Relatively minor expenditures in aircraft equipment may be required.	Changes that effect interchangeability of replaceable components and/or which may require significant scrapping of components. Relatively significant expenditures in aircraft equipment may be required.	Changes to design or construction of product which results in very significant level of scrap. Relatively substantial expenditures in aircraft equipment may be required.
Operating Cost Increase	Negligible change.	Minor (>0.4% for commercial operation)	Significant (>2.0% for commercial operation)	Substantial (>4.0% for commercial operation)
Revenue or Utility Loss	Negligible change.	Minor (>0.1% for commercial operation)	Significant (>0.5% for commercial operation)	Substantial (>1.0% for commercial operation)

Figure 2.2

SAFETY/RESOURCE EVALUATION GUIDE

1. Regulation:

2. Hazard addressed:



**Appendix 3 - USE OF SERVICE EXPERIENCE IN ESTABLISHING
THE CERTIFICATION BASIS FOR A CHANGED PRODUCT**

1. **INTRODUCTION** Service experience may be used to establish the certification basis in accordance with section 21.101(b)(3), when the applicant shows that the proposed certification basis, together with applicable service experience, provides a level of safety commensurate with that expected by compliance with the later standard. A numerical/statistical approach may be used, subject to the availability and relevance of data, however sound engineering judgement must be used.

The essentials of the process involve:

- a. A clear understanding of the rule change and what prompted the change;
- b. A determination based on detailed knowledge of the proposed design feature; and
- c. A comprehensive review of service experience.

In some instances, an applicant may be unable to show that the proposed certification basis, together with the applicable service experience, provides a level of safety comparable with the later regulations. If compliance with the later regulations would then involve a design change, the benefits of such a re-design must be considered in the light of any possible adverse effects of the re-design on operation, reliability, durability, etc.

2. **GUIDELINES** The Issue Paper procedures would be used and the applicant should provide documentation to support the following:

a. The identification of the differences between the rule in the existing basis and the rule as amended, and the effect of the change in the rule.

b. (1) Evidence that complying with the later rule will not enhance safety sufficiently to compensate for the loss of good experience with a well proven/tested system, part or component.

(2) A description of the design feature and its intended function.

c. (1) Identification of the following for the product:

(i) Service experience from such sources as the following:

- Accidents
- Incidents
- Service Bulletins
- Airworthiness Directives
- Repairs
- Modifications
- Flight hours/cycles for fleet leader and total fleet
- World Airline Accident Summary (WAAS) Data
- Service Difficulty Reports
- N.T.S.B. Reports

(ii) Show that the data presented represents all relevant service experience for the product, including the results of any operator surveys.

(iii) Show that the service experience is relevant to the issue.

(iv) Identification and evaluation of each of the main areas of concern relevant to each occurrence, with regard to:

- recurring and/or common failure modes
- cause
- probability, by qualitative reasoning
- measures already taken and their effects.

(2) If relevant data is available for other types of aircraft it may be included.

(3) Confirm understanding of failure modes and consequences through analytical processes. This may include:

- (i) A review of previous test results; and
- (ii) Additional detailed testing.

d. A conclusion that draws together the data and the rationale.

These guidelines are not intended to be limiting, either in setting required minimum elements or in precluding alternative forms of submission. Each case may be expected to be different, based on the particulars of the system being examined and the point to be made. Engineering judgement covers a very wide field which should not be limited in scope to service experience precedents which have previously been set.

3. **EXAMPLE** The following example is provided to illustrate the process, but it does not include the level of detail that would normally be required of an applicant.

"Title: To provide evidence of the Primary Flight Control system and flap system to allow reversion to the earlier standard in lieu of showing compliance with the later standard."

2a. Identify the differences between the rule in the exiting basis and the rule as amended, and the effect of the change in the rule:

"FAR 25.671(c)(3) including amendment 25-23 requires the airplane to be capable of continued safe flight and landing after any jam in a control position normally encountered or after a jam in an adverse position following a control runaway (in the case of a hydraulically operated system), unless these events can be shown to be extremely improbable or can be alleviated."

2b(1). Provide evidence that complying with the later rule will not enhance safety sufficiently to compensate for the loss of good experience with a well proven/tested system, part or component:

"Report J1 documents how the extensive design changes that would be required to comply with FAR 25.671(c)(3) post amendment 25-23 would introduce unknown and unpredictable hazards. Existing good service experience would be invalidated and there would a negative impact on the present ease of inspectability and maintainability."

2b(2). Describe the design feature and its intended function:

"The control circuits are conventional, simple and trouble-free mechanical systems comprising push-pull rods and cables, which are easy to inspect and maintain."

For the new model a number of detail improvements have been introduced for the pitch and roll control circuits to further reduce the already extremely remote probability of a jamming case.

Changes introduced for stability reasons (horn balances on aileron and rudder, and a modified elevator bungee) have been carefully designed so as not to invalidate the excellent service experience with respect to jamming."

2c(1). Review of service experience:

(i) Service experience.

"Documents XX, YY, ... attached provide a summary of the service

experience."

(ii) Show that the data presented represents all relevant service experience for the product, including the results of any operator surveys.

"The following sources were also reviewed but no relevant data was found; Service Difficulty Reports, Airworthiness Directives,..."

(iii) Show that the service experience is relevant to the issue.

"The system has remained unchanged for the life of the aircraft, except as indicated in (1) above."

(iv) Identification and evaluation of each of the main areas of concern.

"The main area of concern is a combined jamming of aileron and rudder when the crew inadvertently engaged the gustlock in flight after they had failed to properly lock the gustlock lever. For the changed aircraft model this situation is not possible as this was one of the few points for detail improvement.

Three cases of restricted elevator movement have led to modifications of elevator support fittings and bonding cable arrangements.

Considering the documentation reviewed, a finding has been made that no modification, introduced during the service life in the primary flight controls and flap system, will invalidate the present good experience."

2c(2). If relevant data is available for other types of aircraft it may be included.

"Relevant data for other types has been reviewed and analyzed with regard to the data for the type under consideration, as summarized in document ZZ."

2c(3). Confirm understanding of failure modes and consequences through analytical processes.

"The previous test data, as contained in documents D1, D2, D3... etc, together with the product improvements, as addressed in documents P1, P2, P3...etc, have been reviewed. The review of the safety analyses verifies that the steps taken have achieved a level of safety comparable with that provided by FAR 25.671(c)(3) including amendment 25-23."

2d. Conclusion:

"Based on a review of service experience and the previous introduction of (accumulated) product improvements, together with safety analyses, all steps have been taken to arrive at an acceptable safety level. It is acceptable to retain FAR 25.671(c)(3) prior to amendment 25-23 in the certification basis for the changed product."